INTERNATIONAL JOURNAL OF FOOD AND NUTRITION SCIENCE VOL2 NO1 JUNE 2013

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

The Effect Of Pretreatment Of Plantain (Musa Parasidiaca) Flour On The Pasting And Sensory Characteristics Of Biscuit

[1]Arisa, Ngozi. U, [1]Adelekan, Aminat. O, [1]Alamu Adediran. E and [1] Ogunfowora, Ebunoluwa. J.
[1] Department of Food Science and Technology, Bells University of Technology, P.M.B 1015, Ota, Ogun State, Nigeria.
bis_adek@yahoo.com

Abstract-The effect of pre-treatment on the pasting and sensory characteristics of plantain biscuit was investigated. The plantain flour was produced using different treatments; the use of sodium metabisulphite ($Na_2S_2O_5$), blanching at 80℃ for 10min and unblanched plantain flour. The protein, fat and carbohydrate content of the flour samples are significantly difference ($p<0.05$) and the unblanched sample had the highest value (6.04%) in protein. Result showed that there were significant difference ($P< 0.05$) in the bulk densities and water absorption capacity. The plantain treated with sodium metabisulphite had the highest value (1.05mg/100g) in sodium content. Pasting time and the final viscosity are significantly difference. The sensory evaluation results showed a significance difference in the appearance, colour, taste, flavour, aroma, crispiness, and the overall acceptability, but plantain treated with sodium metabisulphite was rated the highest by the panelist.

Index Terms - Pre-treatment, Pasting, Plantain biscuit, Sensory.

I. INTRODUCTION

Plantain (*Musa paradisiaca*) is an important staple food in Central and West Africa, which along with bananas provides 60 million people with 25% of their calories. According to FAO [1], over 2.11 million metric tons of plantains are produced in Nigeria annually. However, about 35-60% post harvest losses had been reported and attributed to lack of storage facilities and inappropriate technologies for food processing [2]. When processed into flour it is used traditionally for preparation of gruel which is made by mixing the flour with appropriate quantities of boiling water to form a thick paste [3]. The use of plantain flour for production of baked goods if feasible would help to lessen our total dependence on imported wheat.

The chemical composition of plantain varies with the variety, maturity, degree of ripeness and where it is grown (soil type). The water content in the green plant is about 61% and increases on ripening to about 68%. The increase in water is presumably due to the breakdown of carbohydrates during respiration. Green plantain contains starch which is in the range of 21 to 26%. The starch in the unripe plantain is mainly amylase and amylopectin and this is replaced by sucrose, fructose, and glucose during the ripening stage due to the hydrolysis of the starch [4]. The carbohydrate content reduces to between 5 to 10% when ripe. The sugar content is between 0.9 to 2.0% in the green fruit but becomes more prominent in the ripe state. The titratable acidity of plantain is about twice that of sweet potato [5]. Plantains therefore have a high carbohydrate content (31 g/100 g) and low fat content (0.4 g/100g). They are good sources of vitamins and minerals [6], particularly iron (24 mg/kg), potassium (9.5 mg/ kg), calcium (715 mg/kg), vitamin A, ascorbic acid, thiamin, riboflavin and niacin. The sodium content (351 mg/kg) is low in dietary terms hence recommended for low sodium diets [7; 8; 9].

The amino acid components include; alanine, aminobutyric acid, glutamine, histidine, serine, arginine and leucine. The ascorbic acid is high compared to that of banana. As a starchy staple food, plantain supply about 1 g protein/100 g edible portion [10]. As a healthy adult requires about 0.75 g protein kg-1 day-1 [11], plantain alone cannot meet adult protein needs. The fat content of plantains and bananas is very low, less than 0.5%, and so fats do not contribute much to the energy content. Although the total lipid content remains essentially unchanged during ripening, the composition of fatty acids, especially within the phospholipids fraction has been observed to change, with a decrease in their saturation [12]. The energy value of a food derives from the sum of its carbohydrates, fat and protein content. In the case of plantain, the carbohydrate

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

fraction is by far the most important. The sugars and starches that make up this fraction are present in varying concentrations according to the state of the ripeness of the fruit. The two main components of this starch are amylase and amylopectin, present in a ratio of about 1:5. Sugars comprise only about 1.3% of total dry matter in unripe plantains, but rises to around 17% in the ripe fruit.

Plantain for local consumption undoubtfully, plays a role in food and income security and has the potential to contribute to national food security and reduce rural poverty. This crucial role is still largely ignored by policy makers and therefore special public awareness effort is required to sensitize policy makers in both producing and donor countries. Despite the importance of plantain, major constraints threatening its cultivation in terms of pest and disease infestations, soil fertility, planting materials, postharvest losses, marketing constraints, particularly poor road system and lack of infrastructure and storage facilities and much of the fruits harvested go waste. Plantain processed into flour can store for up to a maximum of two years.

This investigation is aimed at processing a local cultivar of plantain into stable flour as a way of extending the shelf life of ripe plantain fruits, to add value to plantain for both the local markets and for export, thereby ensuring food security. Low cost processing methods, such as solar drying etc., were employed to obtain a product that was then subjected to various analyses to determine the quality and acceptability of the resulting product.

II. MATERIALS AND METHODS

Matured green plantain fruit (*Musa parasidiaca*) was obtained from the International Institute of Tropical Agriculture in Ibadan, Oyo state, Nigeria. Other ingredients such as salt, sugar, margarine, baking powder, milk vanilla flavour plantain Flour, wheat flour and egg were also brought from the Sango market.

A. Methods

Preparation of plantain flour

The matured green plantain fruits bunch was cut into individual fruits and was defingered and weighed. The plantain was washed, peeled and cut to approximately (2 mm thick) using the stainless steel knife. Sodium metabisulfite ($Na_2S_2O_5$) (2.0%) was prepared by dissolving 2 g of the salt in approximately 100 ml of distilled water, the plantain slices were poured inside the 25ml of prepared 2.0% sodium metabisulfite. The sulphited pulp was then dried in the oven dryer at 60℃ for 24 hours to obtain dry chips, the dried chips were milled using the milling machine.

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

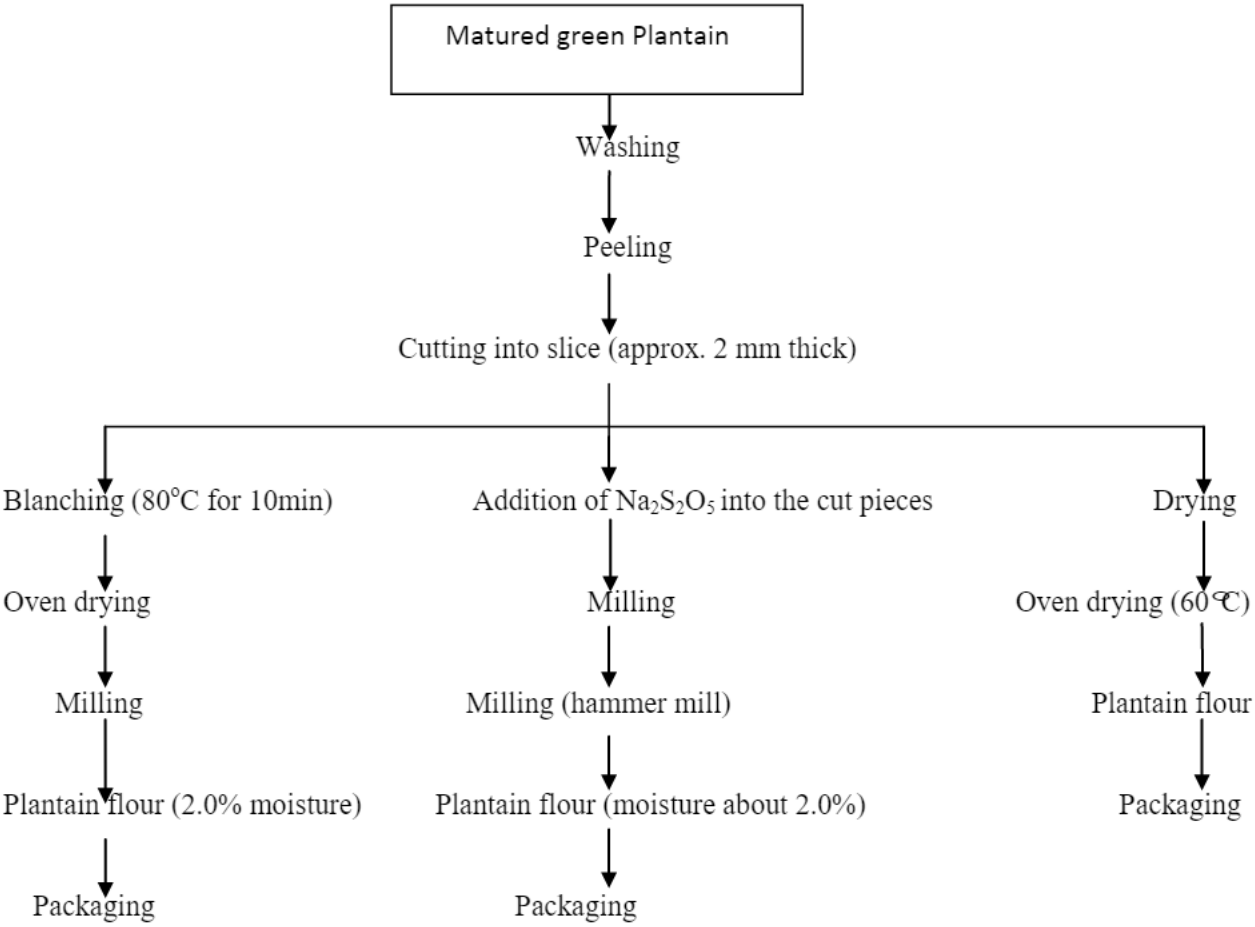


Figure 1: Flow chart for Plantain flour Production

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

TABLE I
RECIPE FOR PLANTAIN BISCUIT

INGREDIENTS	WEIGHTS (g)
Plantain Flour	250
Butter/Margarine	125
Sugar	75
Banana Flavour	2.5
Milk	105
Baking Powder	5
Egg	1

Source: [13].

B Production method

Sugar (75g) was added to margarine (125g) in a Kenwood mixer and mixed at medium speed until fluffy (for about 12 minutes). Egg (1) and milk were added while mixing and then mixed for a total of approximately 30 minutes. Sifted flour (250g), 1 teaspoon of baking powder, ½ teaspoon of banana flavour, was slowly added into the mixture. The mixture was kneaded until dough formation. It was then rolled on a flat rolling board sprinkled with flour to a uniform thickness of about 0.4cm using wooden rolling pin and guiding stick. Circular cookies of 5.8cm to 6cm diameter were cut, placed on oiled baking trays and baked at 160 ℃ for about 15 minutes.

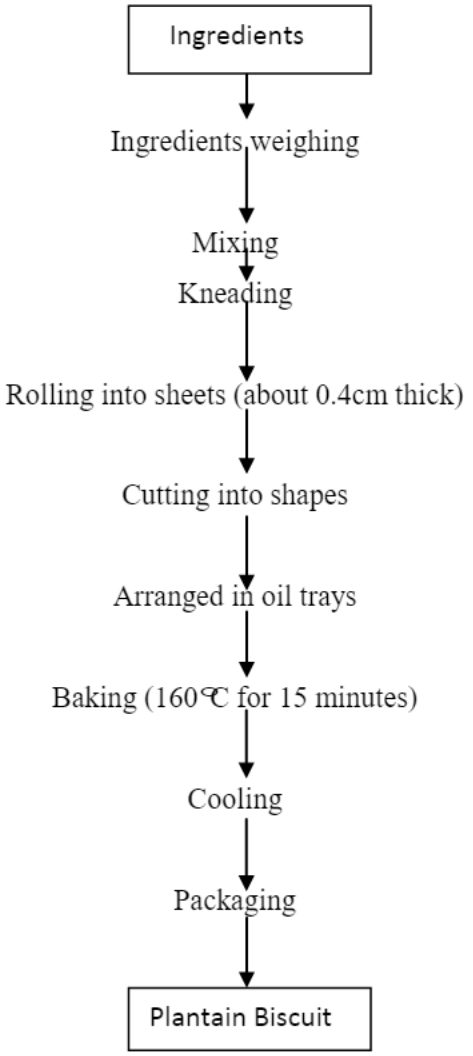


Figure 2: Flow chart for the production of Plantain Biscuit

C. Proximate analysis

The proximate analyses were determined using the procedure of AOAC [14].

D. Determination of nutritional composition

MINERAL CONTENT DETERMINATION

The dry ashing procedure was used for mineral content determination was. Five (5) grams of each of the samples were accurately weighed into porcelain crucibles and pre-ashed until the sample was completely charred on a hot plate. The pre-ashed samples were thereafter ashed in the muffle furnace at 500 degrees Celsius till the ash was white for about 2 hours.

After ashing, the crucibles were transferred into the desiccator to cool and the reweighed. Each sample was quantitatively transferred into volumetric flasks by carefully washing the crucibles with 1ml nitric acid, then with portions of dilute nitric acid.

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

All washings were transferred to individual volumetric flasks, repeating the washing procedure twice. The solutions were diluted to volume with deionized water and were used for individual mineral determination using the appropriate standards and blank. The content of the minerals; **Calcium, Iron, sodium, copper,** were determined with the Atomic Absorption Spectrophotometer (Buck Scientific, Model 210).

The percentage (%) mineral content was calculated as follows:

Calculation:

$$\%\text{Mineral Element Concentration} = \frac{\text{PPM}}{1000}$$

Where Parts per million (PPM) of any element = Meter reading x Slope x Dilution factor

Phosphorus Content

Phosphorus was determined using the Spectrophotometric method. The dry ash of each sample obtained was digested by adding 5mls of 2Molar Hydrochloric acid to the ash in the crucible and heated to dryness on a heating mantle. 5mls of the 2Molar Hydrochloric acid was added again, heated to boil and filtered through a Whatman No.1 filter paper into a 100ml volumetric flask. 10ml of the filtrate solution was pipetted into 50ml standard volumetric flask and 10ml of Vanadate – molybdate yellow was added and the flask was made up to mark with distilled water, stoppered and left for 10 minutes for full yellow development. The concentration of phosphorus was obtained by taking the absorbance of the solution on a Spectronic 21D (Milton Roy Model) Spectrophotometer at a wave length of 470nm.

The percentage (%) phosphorus was calculated with the formula:

% Phosphorus = (Absorbance x Slope x Dilution Factor) / 10000

E. Physical and functional properties

Bulk density determination of plantain flour

This was determined using the method described by Wang and Kinssela [15]. Samples (10g) were weighed into a 50ml graduated measuring cylinder. The sample was packed by gently tapping the cylinder on the bench top for several times until there was no more decrease in volume. The volume of the compacted sample was recorded and the bulk density was calculated as follows

Calculation:

$$\text{bulk density(g/ml)} = \frac{\text{weight of sample (g)}}{\text{volume of sample after tapping (ml)}}$$

Swelling power and solubility

This was determined by the method described of Leach *et al* [16]. One gram of sample was weighed into a 100ml conical flask, 15ml of distilled water was added and mixed gently at low speed for 5mins. The slurry was heated in a thermostatic water bath (THELCO model 83,USA) AT 40mins. During heating, the slurry was stirred gently to prevent lumps forming in the starch. The contents were transferred into pre-weighed centrifuge tubes and 7.5 ml distilled water was added. The tubes containing the paste were centrifuged at 2200 rpm for 20 min using SORVALL GLC – 1 centrifuge (model 06470, USA). The supernatant was decanted immediately after centrifuging into a pre – weighed can and dried at 100^0C to constant weight. The weight of the sediment was taken and recorded.

Calculation:

$$\textbf{Swelling power} = \frac{\text{weight of sediment}}{\text{sample weight} - \text{weight of soluble}}$$

$$\textbf{Solubility index (\%)} = \frac{\text{weight of soluble}}{\text{weight of sample}} \times 100$$

Water absorption capacity (WAC)

This was determined using the method described by Sosulski [17]. To 1g of the sample was added 15ml of distilled water in a pre-weighed centrifuge tube. The tube with its content was agitated on a flask Gallenkamp shaker for 2min and centrifuged at 4000rpm for 20min on a SORVALL GLC-1 centrifuge (Model 06470, USA). The clear supernatant was discarded and the centrifuge tube was weighed with the sediment. The amount of water bound by the sample was determined by difference and expressed as the weight of water bound by 100g dry of flour.

Calculation:

$$\%\text{water absorption capacity} = \frac{\text{final weight} - \text{initial weight of sample}}{\text{weight of sample}} \times 100$$

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

PASTING PROPERTIES

It was determined using the rapid viscous Analyzer [18]. Sample (3.5g) was weighed to the nearest 0.01g into a weighing vessel prior to transfer into the text canister. 2.5 of distilled water were dispensed into test canister. The sample was transferred onto the water surface in the canister. A paddle was placed into the canister and its blade was rigorously jogged through the sample up and down 10 times. Jogging was repeated to ensure that the samples remaining on the water surface or on the paddle were dissolved. The paddle and canister assembly were inserted firmly into the paddle coupling so that the paddle is properly centered. The measurement cycle was initiated by depressing after initiation and terminated automatically.

From the recorded viscosity, the following parameters were read: peak viscosity through holding strength breakdown, set back final viscosity, peak time and pasting temperature [19].

- **Peak viscosity:** (maximum viscosity developed during or soon after the healthy portion of the list in RVU).
- **Peak time:** time at which the peak viscosity occurred in minute.
- **Peak temperature:** temperature at which the peak viscosity occurred, degree Celsius.
- **Pasting temperature:** temperature where viscosity first increased by at least 25 RVU over a 20 seconds.
- **Break down:** peak viscosity minus trough viscosity in RVU.
- **Final viscosity:** viscosity at the end of the test in RVU.
- **Set back from peak:** final viscosity minus peak viscosity in RVU.
- **Set back from tough**: Final viscosity minus trough in RVU.

Assuming the absorbance of an unknown sample is A, and the weight of the sample is W, then the cyanogenic potential can be calculated as

CNP =

$$\frac{A \times 250 \times 0.01093}{b \times W}$$

F. SENSORY EVALUATION OF BISCUIT

The Multiple Comparison test method was used, 3 samples of plantain biscuit and the control were served to a 15 semi-trained panelists who are familiar with the sensory attributes. A 9-point hedonic scale was designed to measure the degree of preference of the samples. The samples were presented in identical containers, coded with 3-digit random numbers served simultaneously to ease the possibility of the panelists to re-evaluate a sample. The categories were converted to numerical scores ranging from 1 to 9, with 1 as the lowest and 9 as the highest level of preference [20].

Necessary precautions were ensured to prevent carry-over flavour during the tasting by ensuring that panelists pass a piece of cracker biscuit in their mouths or rinse with water after each stage of sensory evaluation. Data obtained were subjected to analysis of variance (ANOVA). Means were separated using Duncan multiple range test (SPSS 16.0).

III. RESULTS AND DISCUSSION

The proximate analysis of the control and the plantain flour sample are shown on Table 2. It was observed that the protein content of wheat flour (12.82%) was significantly difference at $p < 0.05$ from the plantain flour samples. The unblanched plantain flour has protein content of (6.04%) as compared to the plantain flour treated with the sodium metabisulphite ($Na_2S_2O_5$) which has (4.27%). The implication of this could be that some of the protein is either leached or denatured by the blanching process [21], and also the sodium metabisulphite treatment applied to the plantain.

There was significant difference ($p < 0.05$) in the moisture content of wheat flour (11.51%), and the treated plantain flour samples, which ranges from (5.16% to 6.27%). However the blanched plantain flour has the lowest value 5.16%. The moisture content goes a long way in suggesting the shelf life of the product. The fat content of the plantain flour was significantly different from the wheat flour. The plantain flour treated with sodium metabisulphite ($Na_2S_2O_5$) was low (2.27%). The lower level of fat in the samples gave a higher probability of a longer shelf-life in terms of the onset of rancidity [22].

The ash content of wheat flour was lower than the plantain flour. The unblanched plantain flour has the highest value (3.08%). The crude fibre and carbohydrate of the wheat flour was significantly difference ($p < 0.05$) from the plantain flour, as well as the treated plantain flour samples.

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

Table II

EFFECT OF PRETREATMENT ON THE PROXIMATE COMPOSITION OF PLANTAIN FLOUR AND WHEAT FLOUR

SAMPLES	ASH (%)	MOISTURE (%)	FAT (%)	PROTEIN (%)	CRUDE FIBRE (%)	CARBOHYDRATE (%)
NPF	2.26±0.01	6.68±0.02	2.27±0.01	4.27±0.08	3.52±0.12	80.99±0.05
BPF	2.76±0.02	5.16±0.03	2.55±0.02	4.31±0.09	2.28±0.07	82.94±0.20
UPF	3.08±0.02	6.27±0.01	2.75±0.02	6.04±0.19	4.44±0.03	77.43±0.23
WF	0.49±0.02	11.51±0.02	1.40±0.01	12.82±0.02	0.81±0.01	72.98±0.06

Mean ±standard error

LEGEND:

NPF: $Na_2S_2O_5$ (sodium metabisulphite) Plantain Flour
UPF: Unblanched Plantain Flour
WF: Wheat Flour
BPF: Blanched Plantain Flour

The effect of pretreatment on functional properties of plantain flour is represented on Table 3. The bulk density of the plantain flour was significantly difference ($p < 0.05$) from the wheat flour, the blanched plantain flour sample had the lowest value of 0.25 g/ml, this is contrary to a report made by Tagogoe [23] and Fagbemi [24] which showed that bulk density increased as a result of blanching/heat treatment prior to drying. The reduction in the bulk density in blanched samples will be an advantage in the bulk storage and transportation of the flour. This is usually affected by the particle size and density of the flour and it is very important in determining the packaging requirement, materials handling and application in wet processing in the food industry.

The water absorption capacity was significantly different ($p < 0.05$) in all the flour samples, but the wheat flour had the highest value of 171.40 % of water absorption capacity and the unblanched plantain sample had the lowest value 125.17%. There was no significant difference ($p > 0.05$) between the wheat flour 40.54% and both the blanched has 39.49% and sodium metabisulphite ($Na_2S_2O_5$) plantain flour has 38.18% water absorption capacity. The unblanched plantain flour was significantly difference ($p < 0.05$). Swelling power is an indication of the absorption index of the granules during heating [25]. The solubility of the wheat flour was significantly difference ($p < 0.05$) from the plantain flour, but the plantain flour treated with the sodium metabisulphite ($Na_2S_2O_5$) and the blanched sample are not significantly difference ($p > 0.05$) from each other.

The proximate composition of the plantain biscuit is shown on Table 4. The results shows that there were no significant differences ($p > 0.05$) in protein between the plantain biscuit treated with sodium metabisulphite ($Na_2S_2O_5$) 5.12% and blanched plantain biscuit 5.27%. The wheat biscuit has the highest value of protein (11.83%) and this is due to the high gluten in wheat flour. The moisture content in the plantain biscuit samples which ranges between (5.90 to 7.10 %) was significantly difference ($p < 0.05$) from the wheat biscuit (12.83%). The ash content of the wheat biscuit (2.99%) was significantly difference ($p < 0.05$) from the plantain

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

biscuit samples, but the unblanched biscuit has the highest value (3.50%) for ash content. The fat content of wheat biscuit (7.52%) was significantly difference ($p < 0.05$) from the plantain biscuit samples which ranges between (3.49 to 4.73%). There was a significant difference ($p < 0.05$) in crude fibre between the wheat biscuit and the plantain biscuit samples, the crude fibre in wheat is lower (1.01%) than the plantain biscuit samples. Carbohydrates are significantly difference ($p < 0.05$) from each other in all the samples.

The mineral composition of the plantain flour is shown on Table 5. The results shows that the sodium content in the plantain flour are significantly difference ($p < 0.05$), but the plantain flour treated with sodium metabisulphite ($Na_2S_2O_5$) has the higher value 1.05mg/100g. This may be due to the chemical treatment given to the plantain using the sodium metabisulphite which increased the sodium content in the plantain. There are significant differences ($p < 0.05$) in the iron content among the treatments of the plantain flour. In phosphorus there was significant difference ($p < 0.05$) among the plantain flour, but there was no significant difference ($p > 0.05$) between the plantain flour treated with sodium metabisulphite ($Na_2S_2O_5$) 0.28mg/100g and the blanched samples 0.34mg/100g. The calcium content in the plantain flour decreased significantly ($p < 0.05$) with the treatments; the plantain treated with sodium metabisulphite ($Na_2S_2O_5$) has the lowest value 1.27mg/100g. There was significant difference ($p < 0.05$) in copper of the plantain samples, but the plantain flour sample treated with sodium metabisulphite has the lowest value (0.53mg/100g).

The pasting properties of plantain flour and wheat flour are shown on Table 6. The pasting properties of starch are used in assessing the suitability of its application as functional ingredient in food and other industrial products [20]. The most important pasting characteristic of granular starch dispersion is its amylographic viscosity [26]. The pasting temperature of the plantain samples ranges between 64.55℃ to 86.65℃ and the control (wheat flour) is 83.45℃.but the blanched plantain flour sample had the lowest pasting temperature. The pasting temperature is a measure of the minimum temperature required to cook a given food sample [27], it can have implications for the stability of other components in a formula and also indicate energy costs [18].

The peak time is a measure of the cooking time [28]. The plantain flour sample treated with sodium metabisulphite ($Na_2S_2O_5$) had the lowest peak time 4.50 min and the control sample (wheat flour) had the highest peak time 5.80 min. Peak viscosity, which is the maximum viscosity, developed during or soon after the heating portion of the pasting test, is lower in the control sample (wheat flour) 215.33 RVU and highest in the blanched plantain flour sample 293.92 RVU. Peak viscosity is often correlated with the final product quality. It also provides an indication of the viscous load likely to be encountered during mixing [29]. Higher swelling index is indicative of higher peak viscosity while higher solubility as a result of starch degradation or dextrinization results in reduced paste viscosity [30]. The hold period sometimes called shear thinning, holding strength, hot paste viscosity or trough due to the accompanied breakdown in viscosity is a period when the sample was subjected to a period of constant temperature (usually 95℃) and mechanical shear stress. It is the minimum viscosity value in the constant temperature phase of the RVA profile and measures the ability of paste to withstand breakdown during cooling [18].

The blanched plantain flour had the highest value of the hold period 259.25 RVU while the plantain flour treated with sodium metabisulphite ($Na_2S_2O_5$) had the lower value 186.75 RVU, the control sample wheat flour and the unblanched plantain flour ranges between (200.67 and 200.83 RVU) respectively. This period is often associated with a breakdown in viscosity [31]. It is an indication of breakdown or stability of the starch gel during cooking. The lower the value the more stable is the starch gel. The breakdown is regarded as a measure of the degree of disintegration of granules or paste stability [18]. The breakdown viscosities of the plantain flour samples ranges between 34.67 to 46.92 RVU and the control sample (wheat flour) had the lowest breakdown viscosity value 14.67 RVU.

The viscosity after cooling to 50℃ represents the setback or viscosity of cooked paste. It is a stage where retrogradation or reordering of starch molecules occurs. It is a tendency to become firmer with increasing resistance to enzymic attack. It also has effect on digestibility. Higher setback values are synonymous to reduced dough digestibility [30], while lower setback during the cooling of the paste indicates lower tendency for retrogradation [27]. The final viscosity of the blanched plantain flour had the highest value 346.83 RVU and the plantain flour sample treated with sodium metabisulphite ($Na_2S_2O_5$) had the lower value 222.58 RVU. The final viscosity for the control sample (wheat flour) is 271.92 RVU. The setback value for the control sample (wheat flour)

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

is 71.25 RVU. The plantain flour treated with sodium metabisulphite had the lowest setback value 35.83 RVU. The setback viscosity indicates the tendency of the dough to undergo retrogradation, a phenomenon that causes the dough to become firmer and increasingly resistant to enzyme attack [22], and has a serious implication on the digestibility of the dough when consumed. Higher setback values are synonymous to reduced dough digestibility [30] while lower setback during the cooling of the paste indicates lower tendency for retrogradation [27].

The result for sensory evaluation is represented on Table 7. This result was evaluated in terms of appearance, colour (crust and crumbs), taste, crispiness, flavor, aroma, and overall acceptability. The appearance of the control (wheat biscuit) was significantly difference ($p < 0.05$) from the plantain flour. However, there was no significant difference ($p > 0.05$) between the plantain samples, but the plantain biscuit treated with sodium metabisulphite was shown to be the least liked by the panelist. The control (wheat biscuit) was significantly difference ($p < 0.05$) in crust colour, the unblanched plantain biscuit sample was rated the highest among the plantain biscuit by the panelist. There was significant difference ($p < 0.05$) in the crumbs colour between the wheat biscuit and the plantain biscuits, but the least liked by the panelist was the biscuit treated with sodium metabisulphite. Crispiness is perceived when food is chewed between molars, and is usually expressed in terms of hardness and fracturability [32]. There was no significant difference ($p > 0.05$) in crispiness between the wheat biscuit and the plantain flour treated with sodium metabisulphite ($Na_2S_2O_5$).

The study shows that there were no significant difference ($p > 0.05$) in taste between the blanched plantain biscuit and the unblanched plantain biscuit, but there was significant difference ($p < 0.05$) between the control (wheat biscuit) and the plantain biscuits. The plantain biscuit treated with sodium metabisulphite was rated highest among the plantain biscuit by the panelist. The flavor of the control (wheat biscuit) was significantly difference ($p < 0.05$) from the plantain biscuits, the unblanched plantain biscuit was shown to be the least liked by the panelist. The aroma was significantly difference ($p < 0.05$) between the control sample and the plantain biscuit sample. There was significant difference ($p < 0.05$) in terms of overall acceptability between the control (wheat biscuit) and the plantain biscuit. Among the plantain biscuit there is no significant difference ($p > 0.05$) between them, the plantain biscuit treated with sodium metabisulphite was rated highest among the plantain biscuit by the panelist.

IV. CONCLUSION

The flour produce with different treatments has significant difference ($p<0.05$) in its proximate analysis except that the protein for blanched plantain flour and the sodium metabisulphite plantain flour has no significant differences ($p>0.05$).

The pretreatment had effect on the functional properties of the plantain flour samples. Flour treated with sodium metabisulphite had the highest water absorption capacity and this gave it is higher affinity to absorb water during production. The absorbent nature of the said flour has quantitative advantage and can be regarded as been economical. The final viscosity was low in the plantain flour treated with sodium metabisulphite ($Na_2S_2O_5$) and this might be due to low protein content present in the flour sample.

The sensory characteristics of the plantain biscuit were significantly difference ($p < 0.05$). However the plantain biscuit treated with sodium metabisulphite had the highest overall acceptability.

V. RECOMMENDATION

The use of plantain in biscuit making, and other food products, would greatly enhance the utilization of this crop in developing countries like Nigeria and West Africa in whole, where the crop has not been optimally utilized.

Further work should be done on the microbiological examination and shelf stability of the plantain flour products to improve the quality of the product.

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

Table III

EFFECT OF PRETREATMENT ON THE PH AND FUNCTIONAL PROPERTIES OF PLANTAIN AND WHEAT FLOUR

SAMPLES	BULK DENSITY (g/ml)	SWELLING POWER (%)	SOLUBILITY (%)	WATER ABSORPTION CAPACITY (%)	pH
NPF	0.76±0.00	38.18±0.04	6.80±0.01	139.19±0.01	6.29±0.00
BPF	0.25±0.00	39.49±0.01	6.47±0.00	130.26±0.01	6.25±0.00
UPF	0.49±0.00	48.89±0.01	5.57±0.01	125.17±0.01	6.12±0.01
WF	0.70±0.00	40.54±2.62	4.67±0.26	171.40±0.01	6.01±0.00

Mean ±standard error

Table IV

Effect of pretreatment on the proximate composition of plantain biscuit and wheat biscuit

SAMPLES	ASH (%)	MOISTURE (%)	FAT (%)	PROTEIN (%)	CRUDE FIBRE (%)	CARBOHYDRATE (%)
NPB	2.54±0.03	7.10±0.03	3.49±0.02	5.12±0.02	2.64±0.02	79.13±0.07
BPB	2.69±0.01	5.90±0.02	3.89±0.01	5.27±0.02	2.15±0.01	80.11±0.02
UPB	3.50±0.02	6.94±0.03	4.73±0.02	7.07±0.08	3.79±0.02	73.97±0.12
WB	2.99±0.02	12.83±0.02	7.52±0.02	11.83±0.03	1.01±0.01	63.83±0.01

Mean ±standard error

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

Table V

EFFECT OF PRETREATMENT ON THE MINERAL COMPOSITION OF PLANTAIN FLOUR

SAMPLE	COPPER (mg/100g)	CALCIUM (mg/100g)	SODIUM (mg/100g)	PHOSPHORUS (mg/100g)	IRON (mg/100g)
NPF	0.53±0.01	1.27±0.01	1.05±0.01	0.28±0.01	1.67±0.02
BPF	0.59±0.01	1.36±0.01	0.52±0.01	0.34±0.01	1.33±0.01
UPF	0.65±0.01	1.52±0.01	0.47±0.01	0.74±0.05	1.25±0.01

Mean ±standard error

Table VI

EFFECT OF PRETREATMENT ON PASTING PROPERTIES OF PLANTAIN FLOUR AND WHEAT FLOUR

SAMPLE	PEAK VISCOSITY (RVU)	TROUGH (RVU)	BREAKDOWN (RVU)	FINAL VISCOSITY (RVU)	SET BACK (RVU)	PEAK TIME (min)	PASTING TEMP (℃)
NPF	241.00	186.75	54.25	222.58	35.83	4.50	65.10
BPF	293.92	259.25	34.67	346.83	87.58	5.21	64.55
UPF	247.75	200.83	46.92	297.50	96.67	5.33	86.65
WF	215.33	200.67	14.67	271.92	71.25	5.80	83.45

Mean ±standard error

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

Table VII

EFFECT OF PRETREATMENT ON THE SENSORY CHARACTERISTICS OF PLANTAIN BISCUIT AND WHEAT BISCUIT

SAMPLE	APPEARANCE	CRUST COLOUR	CRUMB COLOUR	TASTE	CRISPINESS	FLAVOUR	AROMA	OVERALL ACCEPTABILITY
WB	8.20±0.26	8.07±0.18	7.93±0.21	8.13±0.35	7.40±0.42	7.86±0.31	7.40±0.42	8.20±0.28
BPB	5.67±0.39	5.20±0.37	6.07±0.33	5.67±0.54	5.93±0.53	5.40±0.58	5.46±0.54	5.80±0.47
UPB	5.67±0.37	6.00±0.47	5.93±0.45	5.67±0.54	5.93±0.49	5.13±0.49	5.73±0.48	6.27±0.42
NPB	5.27±0.47	5.73±0.44	5.67±0.48	6.33±0.36	6.20±0.39	6.00±0.34	6.20±0.41	6.47±0.31

Mean ±standard error

REFERENCES

[1] FAO (Food and Agricultural Organization) 2004. Food and agricultural indicators. ESSA Oct. 2005. FAO Rome. http://www.fao.org/es/ess/top/country.html.

[2] Olorunda, A.O and M.A. Adelusola. 1997. Screening of Plantain / Banana Cultivars for Import, Storage and Processing Characteristics. Paper Presented at the International Symposium on Genetic Improvement of Bananas for Resistance to Disease and Pests 7 – 9th September, (IRAD, Montpellier, France).

[3] Mepba, H.D, L. Eboh and S.U. Nwaojigwa, 2007. Chemical Composition, Functional and Baking Properties of Wheat – Plantain Composite Flours. Afr. J. Food Agric, Nutr. Dev., 7(1): 4-5.

[4] Marriott, J, M. Robinson and S. K. Karikari. 1983. Starch and sugar transformations during ripening of plantains and bananas. J. Sci. Food Agric. 32: 1021-1026.

[5] Aurand, W.L, A.E. Wood and R.M. Wells.1987. Food composition and analysis, 4th edition, Van Nostrand Reinhold, 115 Fifth Avenue, New York: 19-34.

[6] Adeniji T.A, L.O. Sanni, I.S. Barimalaa and A.D. Hart 2006. Determination of micronutrients and colour variability among new plantain and banana hybrids flours. World J. Chem. 1(1): 23-27.

[7] Izonfuo W.A.L, V.O.T Omuaru. 1988. Effect of ripening on the chemical composition of plantain peels and pulps (*Musa paradisiaca*). J. Sci. Food Agric. 45: 333-336.

[8] Stover, R.H and N.W. Simmonds. 1987. *Bananas*. 3rd ed. Wiley. New York, USA: 97-103.

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

[9] Welford A, L. Izonfuo and F. Victor 1988. Effect of ripening on the chemical composition of plantain peels and pulps (*Musa paradisiaca*). J. Sci. Food Agric. 45: 333-336.

[10] USDA, 2009. National Nutrient Database for Standard Reference, http://www.nal.usda.gov/fnic/foodcomp/plantain/.

[11] Burton, T.B, R.F. Willis 1976. Human nutrition, 4th edition, McGraw Hill Book Company, New York: 566-588.

[12] Ogazi, P.O. 1985. Quality Assessment of Plantain Fruits for Dehydration. Nig. Food J., 4(1): 125-130.

[13] Oyewole, O.B., L.O. Sanni and M.A. Ogunjobi. 1996. Production of biscuits using cassava flour. Nig. Food J., 14: 24-28.

[14] AOAC, 1990. Official Methods of Analysis of the Association of Official Analytical Chemists, 15th ed., AOAC, Arlington, Virginia, USA.

[15] Wang, J.C and J.E. Kinsella. 1976. Functional properties of novel proteins: Alfalfa leaf protein. J. Food Sci., 41: 286-289.

[16] Leach H.W, L.D. McCowan and T.J. Schoch 1957. Structure of the Starch Granule: Swelling Power and Solubility Patterns of Different Starches. Cereal Chem., 36: 534-544.

[17] Sosulski, F. W. 1962. The centrifuge methods for determining flour absorption in hard red spring wheat. Cereal chem. 39: 344-349.

[18] Newport Scientific (1998). Applications manual for the Rapid Visco Analyzer using thermocline for windows. Newport Scientific Pty Ltd., 1/2 Apollo Street, Warriewood NSW 2102, Australia: 2-26.

[19] IITA (2001).Operation manual for the series 3 rapid visco analyzer using thermocline for windows. Newport scientific pty.Lmt.

[20] Iwe, M.O. 2002. Handbook of Sensory Methods and Analysis. Rojoint Communications Services Ltd, Uwani – Enugu Nigeria.

[21] Oluwalana, I.B and M.O. Oluwamukomi. 2011. Proximate composition, rheological and sensory qualities of plantain (*Musa parasidiaca)* flour blanched under three temperature regimes. Afr. J. of Food Sci. Vol. 5(14): 769 – 774.

[22] Ihekoronye A.I and P.O. Ngoddy 1985. Integrated food science and technology for the tropics. 1st ed. McMillan publishers: 261- 291.

[23] Tagogoe, A. 1994. Functional Properties of Raw and Precooked Taro Colocasia Esculenta Flour. Int. J. Food Sci. Tech., 29: 457-482.

[24] Fagbemi, T.N. 1999. Effect of Blanching and Ripening on Functional Properties of Plantain (Musa aab) Flour. Foods Hum. Nutr., 54: 261- 269.

[25] Loos, P.J., L.F. Hood and A.J. Graham. 1981. Isolation and characterization of starch from breadfruit. Cereal Chem., 58: 282-286.

[26] Aviara N.A., O.A. Onuh and S.A. Ehiabhi. 2010. Physical properties of *Mucuna flagellipes* nuts. Seed Science and Biotechnology, 4: 59–68.

[27] Sandhu, K. S, N. Singh and N.S. Malhi 2007. Some properties of corn grains and their flours I: Physicochemical, functional and chapati-making properties of flours. Food Chem., 101: 938-946.

[28] Adebowale, Y.A, I.A Adeyemi and A.A. Oshodi 2005. Functional and physic chemical properties of flour of six Mucuna Species. Afr. J of Biotech. 4 (12): 1461-1468

[29] Maziya-Dixon B, A.G.O. Dixon, and A.A. Adebowale 2004. Targeting different end uses of cassava: genotypic variations for cyanogenic potentials and pasting properties. A paper presented at ISTRC-AB Symposium, 31 October – 5 November 2004, Whitesands Hotel, Mombassa, Kenya.

[30] Shittu T.A, O.O. Lasekan, L.O. Sanni and M.O. Oladosu. 2001. The effect of drying methods on the functional and sensory characteristics of pukuru-a fermented cassava product. ASSET-An Intern. J., 1(2): 9-16.

[31] Ragaee, S., E.M. Abdel-Aal and M. Noaman. 2006. Antioxidant activity and nutrient composition

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

of selected cereals for food use. Food Chem. 98: 32-38.

[32] Noor S, G.M. Ali, U. Rashid, M. Arshad, S. Ali and Y. Zafar. 2009. Optimization of callus induction and regeneration system for Pakistani wheat cultivars Kohsar and Khyber-87. Afr. J. Biotechnol. 8(20): 5565-5569

ISSN 2165-5308 (PRINT) ISSN 2165-5316 (ONLINE) http://www.researchpub.org/journal/ijfns/ijfns.html

